RESEARCH in Progress

Forest Products Laboratory

Evaluation of Decay Effect on Tension Perpendicular to Grain Properties of Wood

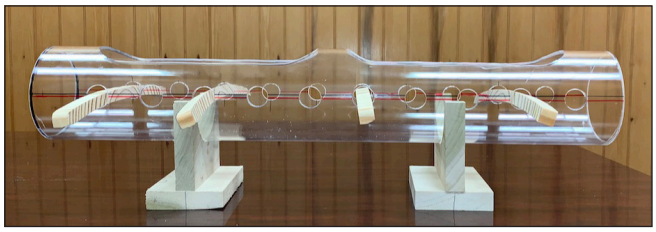

Figure 1. Tube apparatus that will be filled with soil, inoculated, and used for developing decayed specimens.

Wood is used extensively for interior and exterior applications such as residential, agricultural, commercial, industrial, educational, government, and other structures. Deterioration of in-service wood members results from a variety of causes—mainly related to moisture intrusion—during the life of a structure. In addition to routine maintenance and inspections, it is also important to periodically and thoroughly assess the condition of wood used in structures. Of particular importance are identifying and assessing decayed or partially decayed wood members or connections such that degraded members may be repaired or replaced to avoid structural failure. Such assessments are especially critical for building owners, occupants, and officials in municipalities that may be subject to catastrophic wind or other weather/climate-related events that cause temporary but significant overloading. A variety of techniques are available for assessment of wood in structures (Ross at el. 2006; White and Ross 2014). Early detection of decay is critically important for novel building technologies, such as those incorporating cross-laminated timber (CLT), because the fasteners and connections have become increasingly critical.

Background

Tension perpendicular to grain is one of wood's weakest mechanical properties. As such, most structural wood members and connections are designed to avoid development of this stress / orientation. With the increased adoption of CLT, despite best design attempts, tension perpendicular to grain stress often develops at structural connections. Past research related to the influence of decay on physical and mechanical properties of wood has focused primarily on establishing baseline information for the properties of wood parallel to the grain (parallel to the major axis of the wood's fibers). Knowledge of the effect of early decay on tension perpendicular to the grain strength is critical for mass timber panel adoption and design freedom.

Objective

The objectives of this project are to (1) investigate the effect of early decay on fundamental perpendicular-to-grain strength properties of pine and (2) determine the ability of nondestructive testing (NDT) to assess early decay in pine.

Approach

Matched southern yellow pine specimens will be exposed to brown-rot fungi. Specimen mass loss, stress wave speed, and tension perpendicular strength will be correlated to evaluate the effect of decay on tension perpendicular to grain. Matched specimens will be placed in a soil bed tube wherein only the middle portion of the elongated specimens will be in contact with the soil (Fig. 1). This arrangement will permit NDT on specimens that contain active fungi.

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Figure 2. Tension perpendicular to grain test specimen in fixture.

Ideal fungal growth conditions (favorable temperature and soil moisture) will be maintained in the soil tubes. The specimens will be divided into five groups of 20. Four groups will be subjected to brown-rot decay fungi, each for a different period of time (3, 6, 9, and 12 months), and the remaining group will be used as control. Evaluation of specimens will follow the AWPA E23-16 standard procedure (AWPA 2016). Stress wave speed values will be obtained before and after samples are exposed to brown-rot decay fungi. After measuring weight loss and stress wave speed, each specimen will be destructively tested in tension perpendicular to grain (Fig. 2).

Expected Outcomes

The results of this project are expected to provide deeper knowledge on how brown-rot decay affects the tension perpendicular properties of wood products, especially important in the design of connections between wood buildings, mass panels, and members that are jointed and are exposed to moisture intrusion and/or retain moisture. Of critical importance will be the development of nondestructive assessment of initial strength loss from early decay.

Timeline

The project was initiated in June 2019 with the development of a formal study plan. Preparation of test tubes and test samples, collection and preparation of soil, moisture content conditioning, and installation of samples on test tubes will be completed by December 2019. Monitoring of brown-rot tests, visual inspections, NDT evaluation, and mechanical tests will be completed by December 2020. Data analysis of mass loss, stress wave speed, visual ratings, and tension perpendicular strength tests will be ongoing and completed by June 2021.

Cooperators

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References

AWPA. 2016. Laboratory method for rapidly evaluating the decay resistance of wood-based materials in ground contact using static bending: soil jar test. Standard E23-16. AWPA book of standards. Birmingham, AL: American Wood Protection Association.

Ross, R.J.; Brashaw, B.K.; Wang, X. 2006. Structural condition assessment of in-service wood. Forest Products Journal. 56(6): 4–8.

White, R.H.; Ross, R.J. 2014. Wood and timber condition assessment manual. Second edition. General Technical Report FPL-GTR-324. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 102 p.